

Trends in U.S. Residential Natural Gas Consumption

This report presents an analysis of residential natural gas consumption trends in the United States through 2009 and analyzes consumption trends for the United States as a whole (1990 through 2009) and for each Census Division (1998 through 2009). It examines a long-term downward per-customer consumption trend and analyzes whether this trend persists across Census Divisions. The report also examines some of the factors that have contributed to the decline in per-customer consumption. To provide a more meaningful measure of per-customer consumption, EIA adjusted consumption data presented in the report for weather. Questions or comments on the contents of this article should be directed to Lejla Alic at Lejla.Alic@eia.doe.gov or (202) 586-0858.

Appliance efficiency gains, improved housing construction, population shift towards warmer regions, higher commodity price, and an increase in the share of natural gas customers who do not use natural gas as their primary space heating fuel have resulted in a significant decrease in the average volume of natural gas used by U.S. households with natural gas service. Per customer consumption fell in 16 out of the past 19 years. On a weather-adjusted basis, U.S. residential consumption over the 19-year period (1990-2009) fell from 95 thousand cubic feet (Mcf) per customer in 1990 to 74 Mcf in 2009, or 22 percent. This paper analyzes both U.S. as well as regional consumption patterns. However the analysis periods differ because regional historical data is not available prior to 1998. For direct comparison to regional data in this paper, weather-adjusted average U.S. residential consumption decreased 13 percent for the 2007-2009 period compared with the 1998-2000 average.¹

This report presents regional and national residential consumption trends and analyzes some of the factors that have influenced residential customers' consumption over the last decade. Key findings of this analysis are:

- A long-term trend in declining U.S. household consumption is apparent, with year-over-year declines in residential per-customer consumption in 16 out of the past 19 years.²
- Analysis of per-customer consumption by Census Division revealed that in each of the nine divisions consumption decreased over the past 11 years. The West South Central Census Division exhibited the largest decrease in per-customer weather-adjusted average consumption of 20.4 percent, when comparing the 1998-2000 and 2007-2009 average consumption.
- Improvements in construction and appliances contributed to the reduction in average household natural gas use.
- According to EIA data, newer vintage homes, or houses constructed between 1990 and 2005, consumed 25 percent less natural gas for space heating, than homes built prior to 1990.³

¹ This paper analyzes 3-year averages because of significant year-to-year variability in regional data.

² This analysis uses customer count numbers as they are reported in the *Natural Gas Annual*. The number of customers for the Northeast Census Region may be underreported as a result of shared meters in multi-family structures.

³ Data cited in this paper on natural gas use for space heating in homes built prior to 1990 and those built between 1990 and 2005 were derived from data collected on the [Residential Energy Consumption Survey](#).

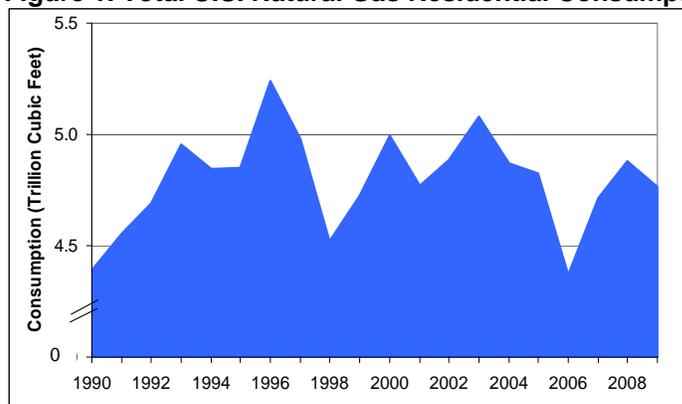
- Natural gas prices may have also contributed to the decrease in natural gas consumption over the last 19 years. Residential natural gas prices have significantly increased since the \$8.50 per Mcf level in the 1990s (constant 2009 dollars), averaging \$11.98 in 2009.

Background

The decline in average consumption per residential household, which began in the 1990s, contributed to the decline in aggregate residential consumption since 1996. This decline in average consumption per residential household more than offset the expanding number of customers, which increased from 50 million in 1990 to more than 65 million customers in 2008. Some variation in the generally downward trend occurred because residential consumption responds to temperatures. EIA derived a weather-adjusted average consumption per-customer measure to account for temperature variations.⁴ The long-term decline was even more apparent when consumption was corrected for temperature variation.

Residential end-users accounted for about 21 percent of the total natural gas consumption in the United States in 2009. The residential sector primarily uses natural gas for space heating, although a significant portion of it is also used for water heating and to power appliances. Total natural gas deliveries to residential consumers in 2009 decreased by about 2 percent compared with 2008, following 2 consecutive years of increase in consumption in this sector (Figure 1).⁵ However, average deliveries to residential consumers have exhibited a general downward trend since peaking in 1996 (Figure 2), concurrent with improving energy efficiency of new homes and heating equipment, and an increasing share of natural gas customers who do not use natural gas as their primary space heating fuel, as well as an increase in residential natural gas prices.

Figure 1. Total U.S. Natural Gas Residential Consumption, 1990-2009



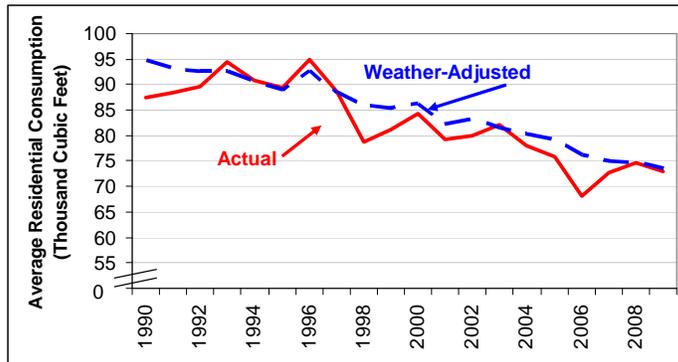
Source: Energy Information Administration, Office of Oil and Gas, *Natural Gas Monthly* (March 2010).

⁴ Energy Information Administration, [Impact of Higher Natural Gas Prices on Local Distribution Companies and Consumers](#), July 2007. Derivation of this series is described Appendix C on page 42.

⁵ The 2009 consumption numbers are based on data in the *Natural Gas Monthly* (March 2010). Final data for 2009 will be released in the *Natural Gas Annual 2009*, which is scheduled to be released in December 2010.

In a previous analysis, the Energy Information Administration (EIA) concluded that per-customer natural gas consumption in the residential sector exhibited a declining trend between 1987 and 2005.⁶ The analysis in this paper extends the study period for consumption across the United States through 2009.⁷ Additionally, this paper analyzes residential consumption trends on a Census Division level to better understand regional effects on trends in consumption per customer.

Figure 2. Average U.S. Consumption per Residential Customer, 1990-2009



Source: Residential consumption: Energy Information Administration, *Natural Gas Monthly* (March 2010). Weather data: National Oceanic and Atmospheric Administration.

Key Drivers of the Decrease in Residential Consumption

Over the last decade, several trends have at least partly caused a decrease in residential natural gas consumption. These include increased efficiency in space-heating equipment and other natural gas appliances and turnover in housing stock in the United States. At the same time, natural gas consumers have experienced some significant increases in natural gas costs during the last decade, which also may have contributed to decreased consumption. Population migration patterns over the last 3 decades to warmer climates have also contributed to the decrease in consumption. Finally, according to the data from the American Community Survey (ACS) the percentage of consumers that use natural gas as their primary heating fuel has decreased, as well.

According to the American Gas Association (AGA), efficiency gains in space-heating equipment and other natural gas appliances accounted for more than half of the reduction in per-customer in consumption since 1990.⁸ The standard natural gas furnace in 1980 had 65 percent annual fuel utilization efficiency (AFUE). Today's furnaces exceed 80 percent AFUE, according to Cambridge Energy Research Associates, Incorporated (CERA).⁹ One-third of all furnaces currently sold measure an AFUE of 90 percent or higher.

⁶ Energy Information Administration, [Impact of Higher Natural Gas Prices on Local Distribution Companies and Residential Consumers](#), 2007, pp. 11-12.

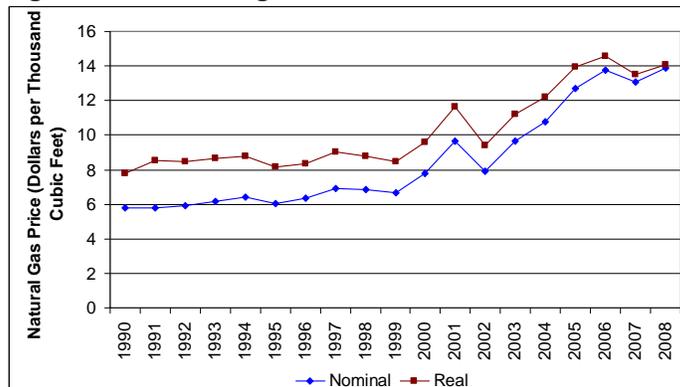
⁷ The current analysis does not start in 1987 because weather-adjusted consumption per customer during 1987 to 1990 varied only between 94.5 and 94.7 thousand cubic feet. This suggests that the downward trend was not present until at least 1990.

⁸ EIA staff conversation with the American Gas Association officials in March 2010.

⁹ Cambridge Energy Research Associates, *Residential Natural Gas Consumption: Heading Toward an Inflection Point?*, September 2009.

Generally higher residential natural gas prices also have reduced consumption, increasing from an average of \$8.50 per Mcf in the 1990s to an average price of \$11.10 per Mcf between 2000 and 2009. Residential prices increased fairly steadily between 1990 and 2006, reaching an annual peak of \$14.58 per Mcf in 2006 (constant 2009 dollars). The residential natural gas price has decreased somewhat since 2006 but still averaged \$11.97 in 2009, which exceeds prices in most of the previous 20 years (Figure 3).

Figure 3. U.S. Average Residential Natural Gas Price, 1990-2009



Note: Real dollars in the figure are in 2009 constant dollars.

Source: Prices: Energy Information Administration, *Natural Gas Monthly* (March 2010). GDP Deflator: Energy Information Administration, *Short-Term Energy Outlook*.

Several studies have been published examining the effect of rising prices on natural gas demand. For example, after estimating the price elasticities of different fuels, EIA reported that total domestic natural gas consumption would be expected to decline by an estimated 1.4 percent for every 10-percent permanent increase in the Henry Hub spot price over a 2-year horizon.¹⁰

In addition to efficiency gains and prices, the increase in the share of ENERGY STAR®-qualified homes built in the United States also offers some explanation for the dramatic decrease in residential consumption. Nearly 110,000 ENERGY STAR®-qualified homes were built in the United States in 2008, a twenty-fold increase compared with the number built in 1998. Preliminary data for 2009 indicated that the number of ENERGY STAR®-qualified homes may surpass that of 2008. According to the EPA, ENERGY STAR®-qualified homes were at least 15 percent more efficient than those built to standards established in 2004 by the International Residential Code (IRC). Energy efficiency of these homes is established based on a set of criteria, which include effective insulation, high-performance windows, tight construction, efficient heating and cooling equipment, and efficient lighting and appliances.

Demographic changes also seem to have affected natural gas consumption in the residential sector. According to CERA, population migration occurred from the Northeast and the Midwest to warmer areas in the South and West. Population in the South and West grew by 1.9 and 1.5 percent, respectively, resulting in a lower U.S. consumption

¹⁰ Energy Information Administration, [Reduced Form Energy Model Elasticities from EIA's Regional Short-Term Energy Model \(RSTEM\)](#), May 2006.

since households in warmer areas of the country consume less natural gas for heating than those in colder climates.

Finally, the Census Bureau reported in the ACS that the percentage of new households that use natural gas as their primary heating fuel has decreased in 2006. The share of all households using natural gas remained stable at about 50 percent, however natural gas is being displaced in many new structures by electricity-powered appliances, which grew from 25 to 35 percent in the United States over the last 20 years.

Regional Consumption Trends¹¹

Each of the nine Census Divisions in the United States (Figure 4) exhibited downward trends in per-customer consumption over the past 10 years. Temporary increases occurred in some Census Divisions, but no evidence pointed to a reversal of the long-term declining trend (Figures 5-13).

Figure 4. U.S. Census Regions and Census Divisions



Source: Energy Information Administration, *Short-Term Energy Outlook*.

Comparing average consumption between 1998-2000 and 2007-2009 reveals steep decreases in each Census Division over the 11-year period (Table 1).¹² Seven out of the nine Census Divisions saw double-digit percentage decreases in average weather-adjusted consumption from 2007-2009 and 1998-2000. The largest percentage decline in per-customer consumption occurred in the West South Central Census Division, where weather-adjusted consumption decreased by 20.4 percent. In fact, this Census Division exhibited the most apparent downward trend of all divisions during the 11-year period (Figure 11). This large decrease likely was the result of 1.3 million new housing units built between 1998 and 2008 that tended to be more energy-efficient overall and equipped with more efficient natural gas appliances. The remaining two Census Divisions in the South Region, East South Central and South Atlantic, saw decreases of 11.1 and 10.8 percent, respectively.

¹¹ Census Division and Region supply source data:

http://www.eia.doe.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/index.html.

¹² To account for any temporary fluctuations in consumption during individual years of the time period 3-year consumption averages at the beginning and end of period were analyzed for each Census Division or Region.

Table 1. U.S. Census Region/Division Average Consumption per Household

Census Region/Division	1998-2000		2007-2009		Percentage Change	
	Actual	Weather Adjusted	Actual	Weather Adjusted	Actual	Weather Adjusted
Northeast	88.7	93.7	85.2	86.6	-3.9	-7.5
New England	85.6	89.9	81.4	82.2	-4.9	-8.5
Middle Atlantic	91.7	97.5	89.0	91.1	-3.0	-6.6
Midwest	99.6	107.9	92.4	92.1	-7.2	-14.7
East North Central	109.3	118.3	100.5	100.7	-8.1	-14.9
West North Central	89.9	97.6	84.4	83.5	-6.1	-14.4
West	73.1	74.8	58.7	60.9	-15.0	-13.7
Mountain	83.7	87.6	65.8	68.6	-12.9	-13.3
Pacific	62.5	62.1	51.5	53.2	-17.5	-14.2
South	68.1	74.1	57.9	60.2	-9.6	-13.9
West South Central	56.6	64.6	49.7	51.4	-12.1	-20.4
East South Central	66.5	72.7	61.7	64.6	-7.1	-11.1
South Atlantic	81.2	85.1	62.3	64.6	-9.9	-10.8

Note: Census Region data shown in bold type. Other information is by Census Division.

Source: Residential consumption: Energy Information Administration, *Natural Gas Monthly* (March 2010).

Weather data: National Oceanic and Atmospheric Administration.

The smallest regional decreases in weather-adjusted natural gas consumption occurred in the Northeast, falling by about 8 percent. In the New England Census Division, weather-adjusted average consumption fell by almost 9 percent. Despite the diversity in housing, weather, and supply sources in each Census Regions, the long-term declining trend was apparent in all of them. Regional differences are apparent in number of customers, average residential price, and other factors (Table 2).

Table 2. U.S. Census Regions, Summary

Census Region	Number of Consumers in 1998/2009 (millions)	Average Residential Natural Gas Price in 2009 (dollars per Mcf)	Percent of Households Using Natural Gas as a Primary Heating Source (2005)	Ranking in Residential Consumption in 2009	Percent Decrease in Natural Gas Consumption in Newer Vintage Homes**	Total Residential Consumption 1998/2009 (Bcf)
Northeast	10.8*/11.8*	15.83	55.3	2	31.8	918/1,027
Midwest	17.3/18.9	10.62	71.9	1	31.4	1,699/1,813
West	14.6/17.9	10.29	60.7	3	14.3	980/989
South	14.7/16.2	13.56	33.4	4	22.8	917/929

* See footnote 2 for an explanation of customer counts.

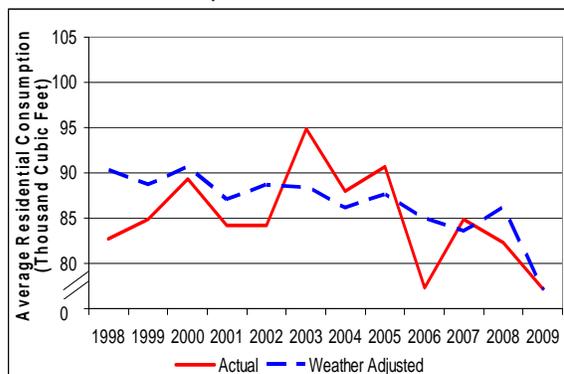
**The decrease in natural gas consumption compares homes built prior to 1990 with those built between 1991 and 2005.

Source: Energy Information Administration: *Natural Gas Annual* and *Natural Gas Monthly*, Census Bureau: *American Community Survey*.

Northeast

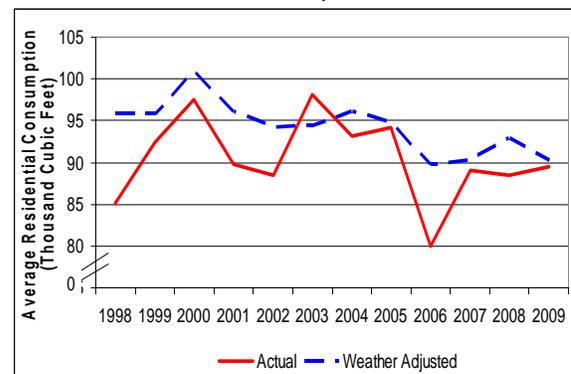
- The Northeast Census Region comprises the Middle Atlantic and New England Census Divisions, covering nine States.
- The Northeast Census Region registered the smallest per-customer natural gas consumption decrease over the 11-year analysis period, falling 3.9 percent from the 1998-2000 average of 88.7 Mcf to the 2007-2009 average of 85.2 Mcf. On a weather-adjusted basis, the decrease was 7.5 percent (Figures 5 and 6).
- Residential customers in these Census Divisions tend to pay some of the highest prices for natural gas in the Nation, second only to the South Atlantic.
- As there is very little indigenous natural gas production in the Northeast, this area of the country relies heavily on natural gas transported via large trunklines from the Gulf Coast area. These trunklines include the Transcontinental Gas Pipeline Company system, which has a system-wide capacity of 8.5 billion cubic feet (Bcf) per day and extends from South Texas to the New York City area.
- The Northeast receives considerable pipeline imports from western Canada and the Sable Offshore Energy Project in the offshore Atlantic. Liquefied natural gas provides supplies to the region through import terminals located in Massachusetts and Maryland.
- Between 1998 and 2008, total households in the Northeast Census Region increased by only 6.5 percent (562,000), while the proportion of total U.S. households in the Northeast fell. This region's relatively constant per-customer consumption is partly the result of the lack of a significant decrease in energy intensity of households and space heating appliances. The vast majority of housing units in the Northeast are older and a very small proportion of the housing stock is less than 10 years old.
- EPA data indicate that the Northeast Census Region was home to the smallest proportion of ENERGY STAR[®]-qualified homes in the United States at the end of 2008, accounting for only about 5 percent of all ENERGY STAR[®] homes in existence at that time.

Figure 5. Average Consumption per Residential Customer in New England Census Division, 1998-2009



Source: Residential consumption: Energy Information Administration, *Natural Gas Monthly* (March 2010). Weather data: National Oceanic and Atmospheric Administration.

Figure 6. Average Consumption per Residential Customer in the Middle Atlantic Census Division, 1998-2009



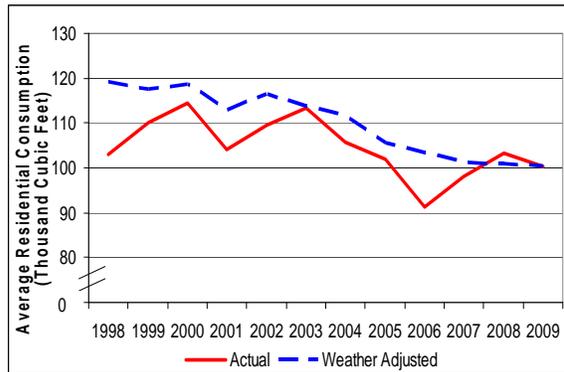
Source: Residential consumption: Energy Information Administration, *Natural Gas Monthly* (March 2010). Weather data: National Oceanic and Atmospheric Administration.

Midwest

- The West North Central and East North Central Census Divisions make up the Midwest Census Region, the area of the country situated roughly between the Rockies and the Northeast Region.
- These two Census Divisions have the highest concentration of households that heat their homes with natural gas. More than 70 percent of its 30 million households use natural gas as their primary source of heat.
- Per-customer deliveries in the Midwest Census Region have decreased significantly in this region over the past 11 years (Figures 7 and 8), after adjusting for weather. The total number of households has increased by 1.5 million over the same time period, while the share of total U.S. households in the Midwest decreased slightly from 24 to 23 percent.
- In the past, the main sources of natural gas for this region have been the panhandles of west Texas and Oklahoma, eastern Texas, Kansas, and Louisiana as well as pipeline imports from western Canada. This region has begun to receive additional natural gas supplies from the Rocky Mountain producing areas with the opening of the Rockies Express-West pipeline. Further penetration of Rockies supplies into this region occurred with the completion of the Rockies Express-East project.
- Since 1998, residential consumers in the West North Central and East North Central Census Divisions have paid lower prices for natural gas on average than anyone outside the Mountain Census Division.
- The comparatively lower residential prices in these divisions are the result of their close proximity to large-volume producing areas in both the United States and Canada, which provide the divisions with access to a large and diverse set of supplies. The Midwest Region received nearly 46 percent of total natural gas imports from Canada in 2008, the largest share of Canadian imports.¹³
- Newer vintage homes in this Census Region constructed between 1990 and 2005, consumed an average of 31 percent less natural gas for space heating compared with homes built prior to 1990, according to EIA's Residential Energy Consumption Survey. At the same time, the Midwest Census Region saw an increase of more than 100,000 ENERGY STAR[®]-qualified homes between 1998 and 2008, according to EPA data. As of the end of 2008, the total number of ENERGY STAR[®]-qualified homes in the Midwest represented about 6 percent of the U.S. total.

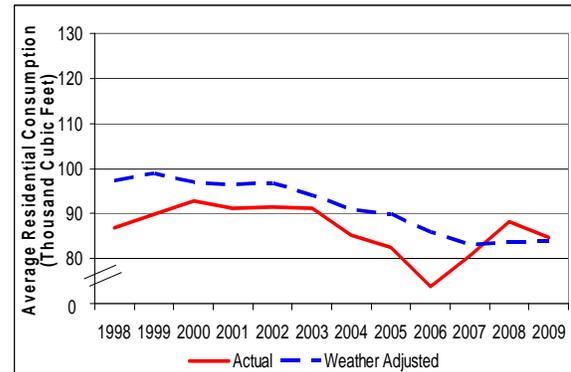
¹³ Energy Information Administration, [U.S. Natural Gas Imports and Exports: 2008](#).

Figure 7. Average Consumption per Residential Customer in East North Central Census Division, 1998-2009



Source: Residential consumption: Energy Information Administration, *Natural Gas Monthly* (March 2010). Weather data: National Oceanic and Atmospheric Administration.

Figure 8. Average Consumption per Residential Customer in West North Central Census Division, 1998-2009



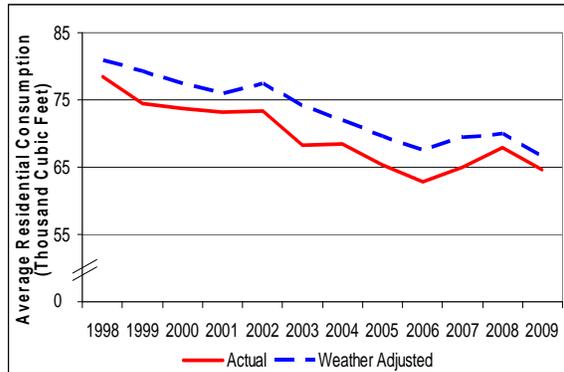
Source: Residential consumption: Energy Information Administration, *Natural Gas Monthly* (March 2010). Weather data: National Oceanic and Atmospheric Administration.

West

- The West Census Region comprises the Mountain and Pacific Census Divisions. This area covers the Rocky Mountains, desert Southwest, and the entire Pacific Coast.
- The West Census Region registered a 15-percent decrease in per-customer natural gas consumption over the 11-year analysis period, with the Pacific and Mountain Census Division decreasing 17.5 and 12.9 percent, respectively. On a weather-adjusted basis, the decreases in the two Census Divisions were 14.2 and 13.3 percent, respectively (Figures 9 and 10).
- Weather, consumption patterns, and supply availability vary greatly between these two Divisions. For example, some areas included in the Mountain Census Division are among the most prolific natural-gas-producing areas in the country. These include areas in Colorado, New Mexico, Montana, and Wyoming, where coalbed methane is extracted from the San Juan, Raton, and Powder River Basins.
- Limited transportation capacity out of this region has led to significantly lower prices than elsewhere in the country. While the construction of the Rockies Express-West pipeline has ameliorated some of the issues associated with the adequacy of available transportation, residential consumers in the States included in the Mountain Census Division generally continue to pay the lowest prices of residential customers in the United States.
- In the Pacific Census Division, the combination of centers of comparatively high demand, cold temperatures during the winter in some areas, limited indigenous production, and higher transportation cost has resulted in slightly higher prices compared with the Census Divisions in the Midwest and West South Central. Overall, residential consumers in the Pacific Census Division paid about 95 cents per Mcf more on average than residential customers in the Mountain Census Division over the past decade.

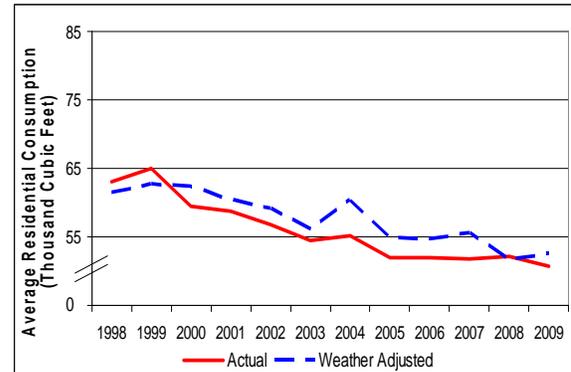
- On a Census Region level, the West accounts for about 41 percent of the total number of ENERGY STAR[®]-qualified homes in the United States, with the Pacific and Mountain Census Divisions accounting for 19 and 22 percent, respectively.
- The Mountain Census Division recorded newer homes (built between 1990 and 2005) as consuming 30 percent less natural gas for space heating compared with older homes (built prior to 1990), according to RECS. The Pacific Census Division, however, registered 1-percent increase in natural gas consumption for new homes.

Figure 9. Average Consumption per Residential Customer in the Mountain Census Division, 1998-2009



Source: Residential consumption: Energy Information Administration, *Natural Gas Monthly* (March 2010). Weather data: National Oceanic and Atmospheric Administration.

Figure 10. Average Consumption per Residential Customer in the Pacific Census Division, 1998-2009



Source: Residential consumption: Energy Information Administration, *Natural Gas Monthly* (March 2010). Weather data: National Oceanic and Atmospheric Administration.

South

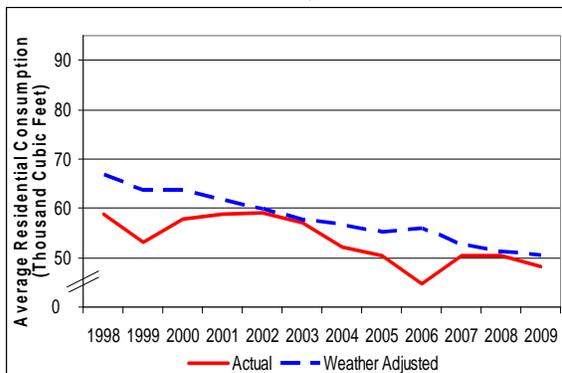
- The South Census Region includes the West South Central, East South Central and the South Atlantic Census Divisions. This region is home to the largest natural gas producing areas, accounting for about 52 percent of the U.S. total.
- The actual per-customer consumption decreased 9.6 percent in the South Census Region over the 11-year period, with the weather-adjusted consumption registering a somewhat bigger decrease at 13.9 percent. On a Census Division basis, analysis of consumption data for the West South Central Census Division showed the largest decrease of any Census Division in the country, falling by 20.4 percent on a weather-adjusted basis (Figures 11 to 13).
- The West South Central and East South Central Census Division have generally enjoyed lower natural gas prices because of their proximity to large sources of natural gas. However, an increase in the use of natural gas for electric power generation in southern States may have exerted upward pressure on commodity prices and thus on residential prices as well.¹⁴ For example, the 2009 average prices in the West South Central and East South Central Census Divisions were \$11.93 per Mcf and \$13.42 per

¹⁴ Three out of the top five States that consumed natural gas for electric power generation in 2007 are in the South region of the United States (Texas, Florida, and Oklahoma). Source: Energy Information Administration, *Natural Gas Annual 2008*.

Mcf, respectively. The 11-year (1998-2009) average residential prices in the West South Central and East South Central Divisions were \$10.09 per Mcf and \$11.12 per Mcf, respectively.

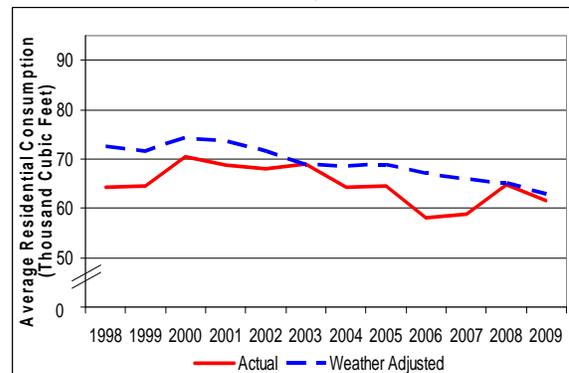
- The South Census Region experienced the highest growth in new households over the 11-year (1998-2009) period of any region in the United States. In fact, this region saw household growth that was almost as high as all of the other regions combined, at 4.7 million new households. Most of these households occupied newer housing units, which were significantly more energy efficient in both construction and appliances. The disproportionate amount of new housing stock in the South has significantly decreased energy intensity, resulting in lower per-customer consumption in the region.
- In 2008, 34,876 new ENERGY STAR[®]-qualified homes were built in the West South Central Census Division, representing nearly 32 percent of the U.S. total increase, according to EPA data. Overall, the number of ENERGY STAR[®] homes in existence as of the end of 2008 in West South Central Census Division accounted for 31 percent of the total U.S. stock, the highest proportion of any Census Division. At the same time, the East South Central Census Division accounted for less than 1 percent of the U.S. total.
- The West South Central Census Region also experienced the highest drop in natural gas use for space heating, according to RECS. In comparison between natural gas use per household in older homes (built prior to 1990) and newer homes (built between 1990 and 2005), West South Central recorded a 48-percent decrease in natural gas consumption in the newer homes. Overall in the South Census Region, natural gas consumption in newer vintage homes (built between 1990 and 2005) decreased by an average of 23 percent.

Figure 11. Average Consumption per Residential Customer in the West South Central Census Division, 1998-2009



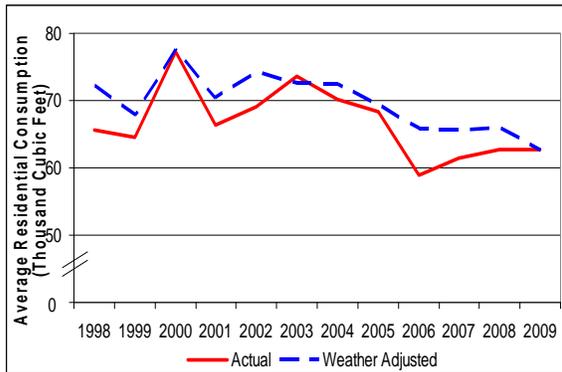
Source: Residential consumption: Energy Information Administration, *Natural Gas Monthly* (March 2010). Weather data: National Oceanic and Atmospheric Administration.

Figure 12. Average Consumption per Residential Customer in the East South Central Census Division, 1998-2009



Source: Residential consumption: Energy Information Administration, *Natural Gas Monthly* (March 2010). Weather data: National Oceanic and Atmospheric Administration.

Figure 13. Average Consumption per Residential Customer in the South Atlantic Census Division, 1998- 2009



Source: Residential consumption: Energy Information Administration, *Natural Gas Monthly* (March 2010). Weather data: National Oceanic and Atmospheric Administration.

Conclusion

An analysis of total U.S. residential natural gas consumption on a per-customer basis, adjusted for weather found that there has been a long-term downward trend in residential consumption, confirming earlier EIA analysis.

Every Census Division exhibited a downward trend in per-customer consumption. When the data were adjusted for weather, this downward trend became even more apparent. While some Census Divisions had periodic upticks in per-customer consumption, these increases were only transitory and did not reverse the long-term downward trend.

The largest decline in per-customer consumption occurred in the West South Central Census Division, decreasing by 20.4 percent per customer when the 1998-2000 and 2007-2009 averages were compared. All other Census Divisions exhibited lesser degrees of consumption declines. Areas in the Northeast saw the smallest decreases in consumption overall.

